



Very Closely Spaced Parallel Approaches (VCSPA)

Terminal Area Capacity

Enhancement Concept (TACEC)

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Presentation Outline

- **Problem Overview**
- **Current Operations**
- **TACEC Solution**
- **Operational Concept**
- **Modeling/Simulation**
- **Summary**





Problem Overview

- **Terminal Area (TA) Capacity**
 - Terminal Airspace
 - Ground Facilities
 - Runways, Taxiways, Ramps...
 - Approx. 2X Traffic Increase by FY2020
 - Increase in number of Delays and Cancellations



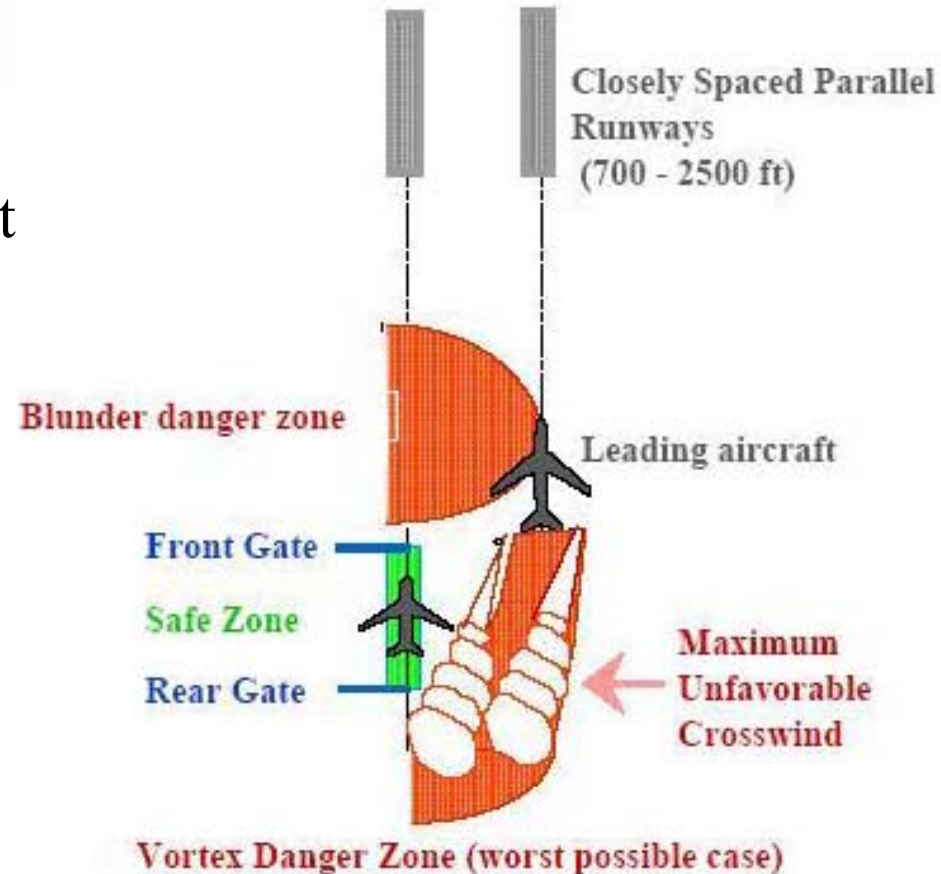
Problem Overview

- **Causing Factors**
 - Safe Separation Distance
 - In-trail Separation Distance (3-6 nm)
 - Number of Runways
 - Runway Occupancy Time
 - Taxiing Time
 - Gate Availability
 - Passenger Accommodation Facilities



Current Operations

- **SFO Operations**
 - Visual vs. Instrument Flight Rule (VFR vs. IFR)
- **Wake Vortex**
- **Blunder**
- **Aircraft Classes (Size)**
 - Directly Related to WV & Blunder

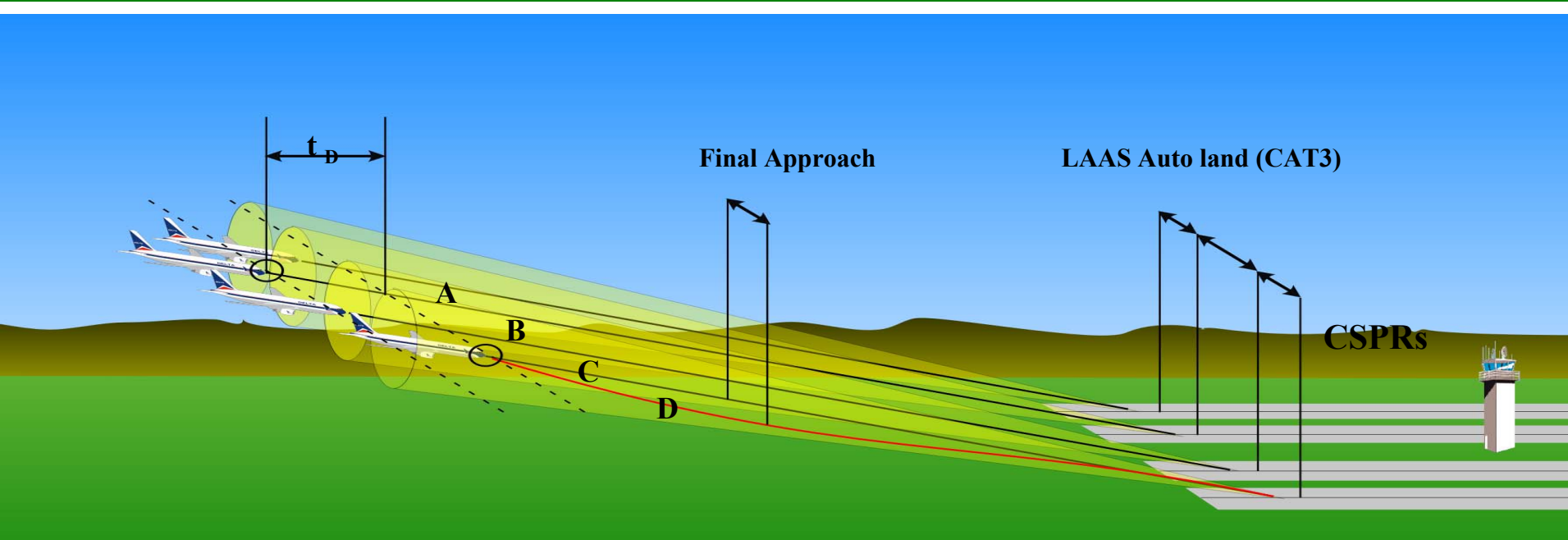
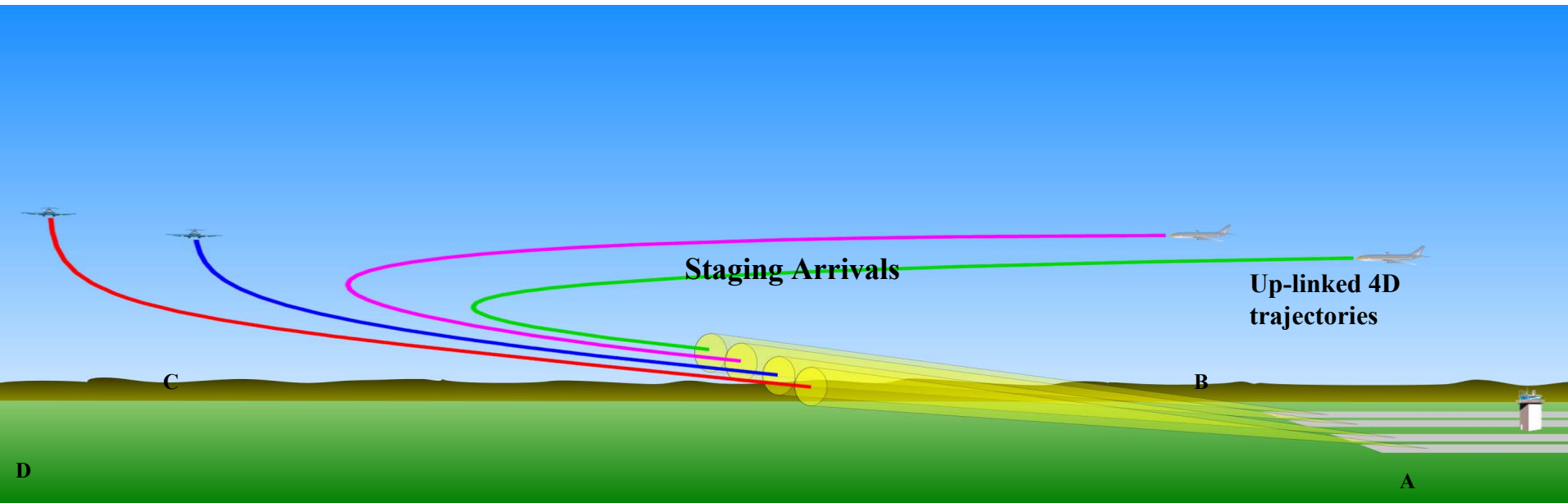




TACEC Solution

- **Terminal Area Capacity Enhancement Concept**
 - ATM concept on the Terminal and Surface domains
 - Meeting the Wake Vortex Avoidance Requirement
 - Different Approach Than In-trail Separation
 - Additional Runways

TACEC Solution





TACEC Operations Concept

- **Vision**
 - VCSPA Operations under IFR
- **Objectives**
 - Land Paired Aircraft on Closely Spaced Runways of Distances ≤ 750 ft
 - GPS/LAAS to Provide for CAT-IIIB Landing Conditions (Full Auto Landing)
 - ADS-B/CDTI to Improve Situational Awareness



TACEC Operations Concept

- **Objectives...**
 - Aircraft Classification Based on Performance
 - Assess Probability of Mid-Air Collision to Determine Lateral Separation
 - Determine Capacity Increase Due to VCSPA Operations



Benefits

- Increase Capacity Two Fold
- Increase Situational Awareness and Navigational Accuracy
 - Increase Level of Safety and Reduce Risk of Collision
- Increase Passenger Satisfaction
 - Increase Schedule Reliability & Reduce Delays
- Reduce Implementation & Operations Cost



Very Closely Spaced Parallel Approaches (VCSPA)

Terminal Area Capacity

Enhancement Concept (TACEC)

Modeling and Simulation



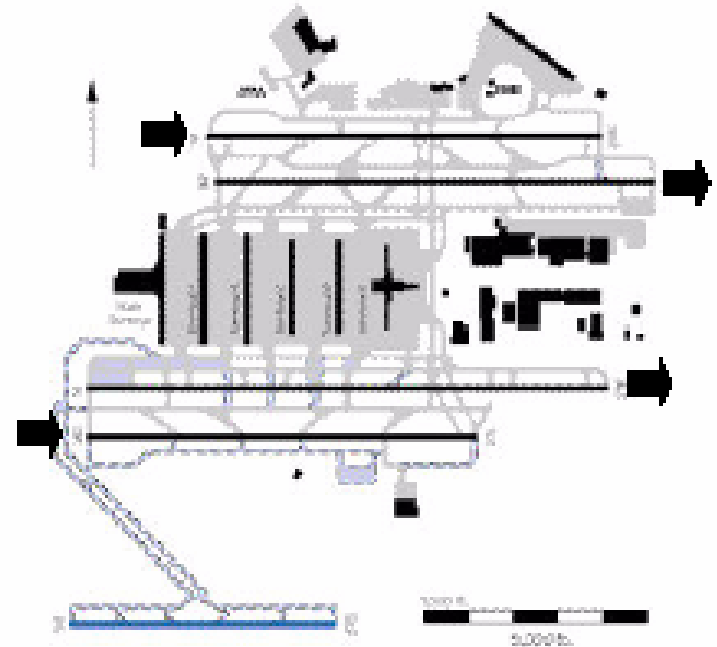
Airport Selection

- **Selection Criteria**

- Large Traffic Flow
- Long Delays
- Runway Layout

- **Original Candidates**

- DFW, ATL, SFO, STL, LGA





Modeling/Simulation

- **Time-Based Simulation**
 - Create a Baseline Model for Current Operations
 - Simulating the Current Operations Model
 - Increase Traffic and Measure Effects on Capacity
- **Spaced-Based Simulation**
 - Research Total System Error
 - Examine Probability of Collision with VCSPA Operations
 - Analyzing Safe Lateral Separation Distance



Modeling/Simulation

- **Time-Based**
 - Queuing, Sequencing, Landing
 - Pair Appropriate Aircraft Based on Performance Characteristics
- **Objective**
 - Minimize Queue Time
 - Maximize Throughput for Arrivals

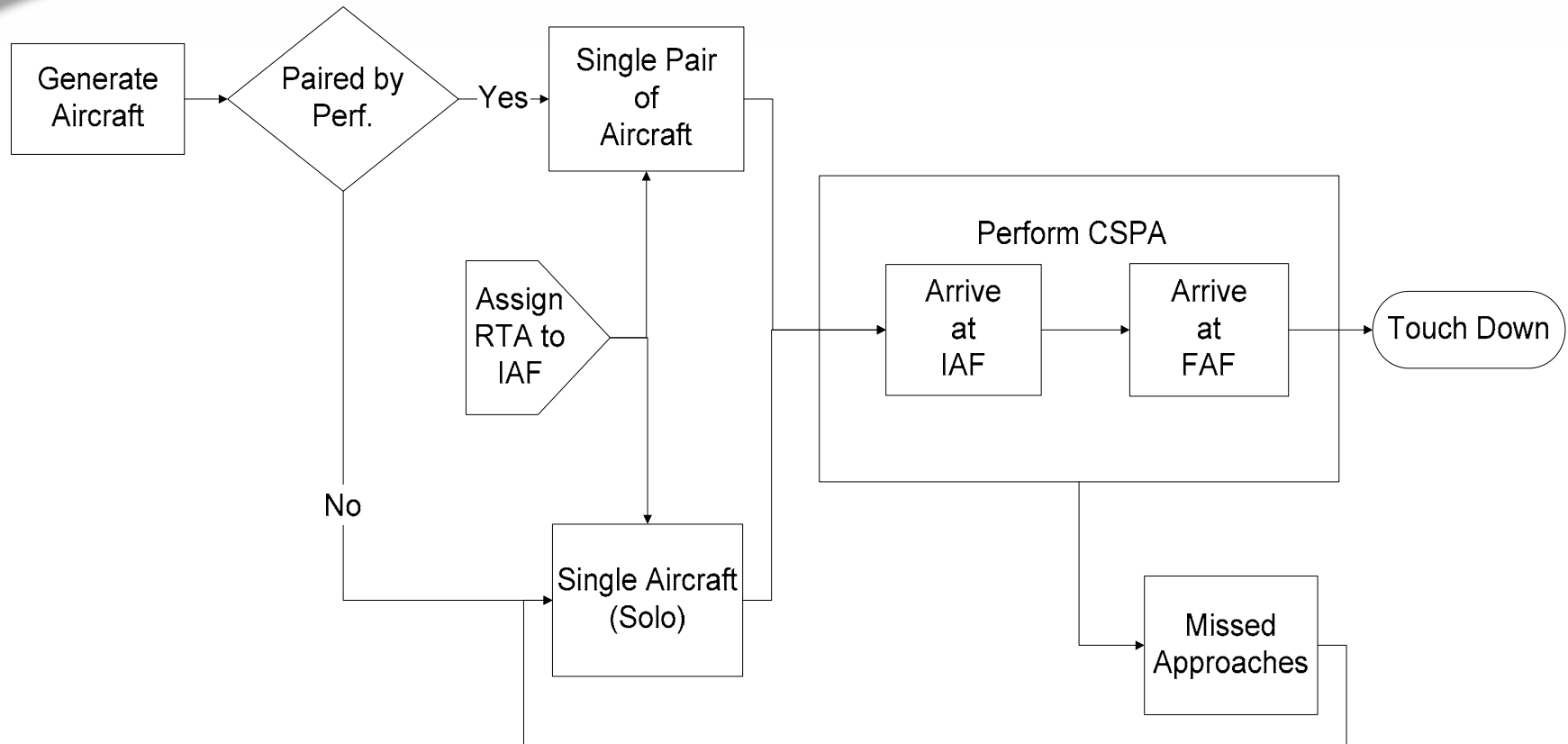


Time-Based Simulation

- **Data Acquisition**
 - Flight Explorer TM
 - Inter-arrival and Flight Time Distributions
- **Baseline of Current Operations**
 - Adjust Model to Fit Data
- **2020 Model**
 - Increase Input by Two Fold
 - Implement TACEC Model
 - Investigate Output of the Simulation



TACEC Simulation





Space-Based Simulation

- **Positional Errors**

- Total System Error (TSE)= NSE + FTE
- Navigation Sensor Error (NSE)
- Flight Technical Error (FTE)

- **Objectives**

- Reduce Probability of Collision
 - Hard and Soft Collision
- Minimize Safe Lateral Separation Distance



Space-Based Simulation

- **Assumptions**

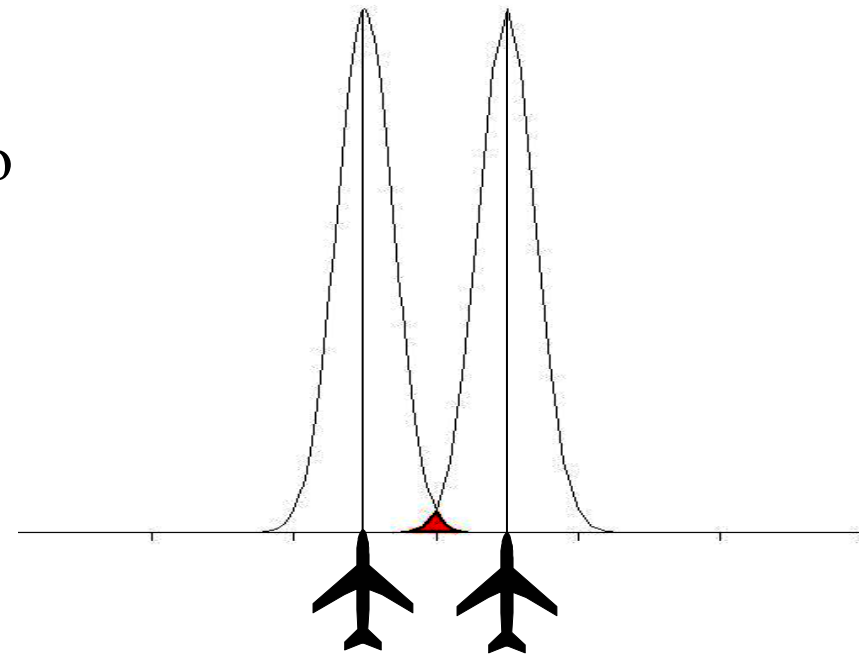
- NSE Compared to FTE
- Single Pair Executing VCSPA
- GPS/LAAS + ADS-B Equipped Aircraft
 - Autopilot and Pilot Approaches

Parameter	1 σ Value (in feet)
Piloted FTE	16
Auto-pilot FTE	11.9
LAAS NSE	4.9



Collision Probability

- VCSPA Operations
 - TSE of Two Aircrafts Conducting Piloted and Auto Piloted Approach
 - Reduce Lateral Separation Distance
 - Assess Collision and Risk Probabilities at Different Separation Distances



Aircraft Separation (ft)



Future Work

- Simulation Analysis
 - Overall Throughput Increase
 - Affects of Traffic Increase on NAS
 - Minimum Safe Lateral Separation
 - Additional Runways Between Existing Ones
- Assessment of Controller vs. Pilot Responsibility During VCSPA